

**CLAIMS**

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is as follows:

- 1        1. A method of improving the scalability of real-time collaboration among  
2        clients in a peer-to-peer network comprising the step of providing a timestamp  
3        and priority-based serialization protocol that can substitute for a centralized  
4        server-based serialization protocol of a real-time collaboration session.
- 1        2. The method of claim 1, wherein the timestamp used is based on one global  
2        clock which is distributed and kept synchronized among the clients  
3        participating in the collaboration session.
- 1        3. The method of claim 2, wherein clock distribution and maintenance of  
2        clock synchrony is done by Network Time Protocol (NTP).
- 1        4. The method of claim 2, wherein clock distribution and maintenance of  
2        clock synchrony is done by Simple Network Time Protocol (SNTP).
- 1        5. The method of claim 2, wherein clock distribution and maintenance of  
2        clock synchrony is done by an interactive convergence protocol.
- 1        6. The method of claim 2, wherein clock distribution and maintenance of  
2        clock synchrony is done by of manual intervention and manual cues.
- 1        7. The method of claim 1, wherein clients are fully connected to each other by  
2        first-in, first-out (FIFO) communication channels.

- 1      8. The method of claim 1, wherein incorrect serializations of modifications  
2      can occur, which then can be undone and corrected using a rollback  
3      mechanism.
- 1      9. The method of claim 8, wherein rollback of serialization decisions have  
2      well-defined and known, upper and lower time/timestamp bounds.
- 1      10. The method of claim 9, including optimizations which eliminate a need for  
2      rollback when an accompanying latency and communication costs are  
3      acceptable.
- 1      11. The method of claim 9, including checkpoints in order to provide  
2      additional safety and reduce memory requirements arising from the rollbacks.
- 1      12. The method of claim 9, wherein checkpoints can be all be locally stored by  
2      each client, or shared by multiple clients with say only one checkpoint storage  
3      for the multiple clients, the multiple clients sometimes being restricted to  
4      being only neighbors of each other.
- 1      13. The method of claim 1, wherein as long as there is at least one client  
2      present in a collaboration session at any time, any client participating in the  
3      collaboration session can be either dynamic or static, which means that either  
4      the client can participate in the collaboration session from start to finish, or it  
5      can join and/or leave the collaboration session while the session is ongoing.
- 1      14. The method of claim 13, wherein dynamic joining of clients is based on a  
2      checkpoints mechanism.

1 15. The method of claim 14, including an optimization wherein an introducer  
2 for a dynamically joining client provides a more developed version of a  
3 workspace than a checkpoint identified for the joining client, thereby reducing  
4 computation, space requirements and communication requirements for the  
5 joining purpose.

1 16. The method of claim 14, wherein a more developed version of a  
2 workspace provided by an introducer can comprise a checkpoint identified for  
3 joining, developed further by incorporating all serialized modifications  
4 available with the introducer up to or before a rollback window for the  
5 introducer at the time of communicating the workspace to the joining client.

1 17. The method of claim 1, wherein multiple definitions of a modification are  
2 supported, including partitioning-based modifications.

1 18. The method of claim 17, wherein partitioning-based modifications are  
2 fully supported, including inter-partition synchronisation via modifications  
3 over multiple partitions, wherein multiple partitions can comprise all kind of  
4 partition hierarchies and partition groups.

1 19. The method of claim 1, wherein locking and unlocking of workspace  
2 partitions are supported.

1 20. The method of claim 19, wherein the support for locking and unlocking  
2 reuses a serialization mechanism.

1        21. The method of claim 1, including an optimization for light-weight clients  
2        wherein a back-end process takes over storage intensive aspects of  
3        serialization that would ordinarily be carried out by the clients themselves.

1        22. The method of claim 1, including a method of dynamically switching to a  
2        distributed server and back in order to utilize a distributed server for periods  
3        of network response when a distributed server is better suited to supporting  
4        real-time collaboration than the serialization protocol.

1        23. The method of claim 1, wherein interoperability is improved across  
2        heterogeneous software/hardware platforms by improving efficiency and  
3        scalability of real-time collaboration without relying on any specialized  
4        support from the network/back-end supporting the real-time collaboration.

1        24. The method of claim 1, wherein interoperability in heterogeneous  
2        environments is improved by being able to work in conjunction with a  
3        distributed server for providing an improvement in the efficiency/scalability/  
4        throughput of real-time collaboration.

1        25. The method of claim 1, wherein interoperability in heterogeneous  
2        environments is improved by including special support via optimizations and  
3        methods oriented towards lightweight clients suited to pervasive devices,  
4        which are likely to comprise a large part of heterogeneous environments in the  
5        near future.